Product Information

DATE : 26. Mar. 2012

SAMSUNG TFT-LCD

MODEL : LTA320HN05 (FHD, 60HZ)

The Information Described in this Specification is Preliminary and can be changed without prior notice

LCD Business

Samsung Electronics Co . , LTD.

Contents

* <u>Revision History</u>

Date	Rev. No	Page	Summary
26. Mar, 2012	000	-	First Issued

General Description

Description

LTA320XXXX is a color active matrix liquid crystal display (LCD) that uses amorphous silicon TFT(Thin Film Transistor) as switching components. This model is composed of a TFT LCD panel, a driver circuit and a back light unit. The resolution of a 32.0" is 1920 x 1080 and this model can display up to 1.07G colors with wide viewing angle of 89° or higher in all directions. This panel is intended to support applications to provide a excellent performance for Flat Panel Display such as Home-alone Multimedia TFT-LCD TV, Display terminals for AV application products, and High Definition TV (HDTV).

Features

- RoHS compliance (Pb-free)
- High contrast ratio, high aperture ratio, fast response time
- SPVA (Super Patterned Vertical Align) mode
- Wide viewing angle ($\pm$89°)
- Full HD (1920 x 1080 pixels) resolution (16:9)
- Low Power consumption
- WLED (White Light Emitting Diode) Backlight
- LVDS (Low Voltage Differential Signaling) interface

General Information

Items	Specification	Unit	Note
Module Size	727.6(H_{TYP}) x 424.0(V_{TYP})	mm	$\pm$1.0mm
	26.0(D_{MAX})		
Weight	4800(Max)	g	
Pixel Pitch	0.12125(H) $\times$ 0.36375(V) * 3	mm	
Active Display Area	698.4(H) x 392.85(V)	mm	
Surface Treatment	Haze 0.8%, Hard-coating (2H)		
Display Colors	8+2 bit- 1.07G	colors	
Number of Pixels	1920 x 1080	pixel	
Pixel Arrangement	RGB Vertical stripe		
Display Mode	Normally Black		
Luminance of White	450	cd/m^2	Typ.

1. Absolute Maximum Ratings
1-1 Operating Condition

If the condition exceeds maximum ratings, it can cause malfunction or unrecoverable damage to the device.

Item	Symbol	Min.	Max.	Unit	Note
Power Supply Voltage	V_{DD}	GND-0.5	*13*	V	(1)
Module Storage Temperature	T_{STG}	-20	60	℃	(2)
Operating Temperature	T_{OPR}	0	50	℃	(2)
Shock (non – operating)	S_{NOP}	-	50	G	(4)
Vibration (non – operating)	V_{NOP}	-	1.5	G	(5)

Note (1) Ta= 25 $\pm$ 2 ˚C
    (2) Temperature and relative humidity range are shown in the figure below.
        a. 93.8 % RH Max. (Ta ≤ 40 ˚C)
        b. Maximum wet-bulb temperature at 40 ˚C or less. (Ta ≤ 40 ˚C)
        c. No condensation
    (3) Polarizer will not be damaged in this range, even though abnormal visual problems occur
        in T_{SUR} range.
    (4) 11ms, sine wave, one time for $\pm$X, $\pm$Y, $\pm$Z axis
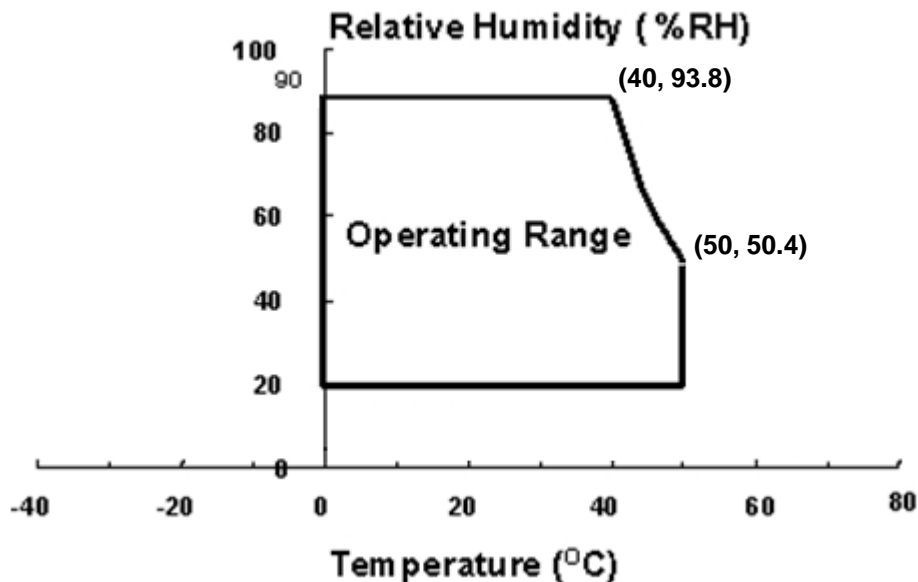   (5) 10-300 Hz, Sweep rate 10min, 30min for X, Y, Z axis

Fig. Temperature and Relative humidity range

2. Optical Characteristics

The optical characteristics should be measured in a dark room or equivalent.
Measuring equipment : TOPCON BM-7,SPECTRORADIOMETER SR-3

(LED Input Current = 110mA, Ta = 25 $\pm$ 2°C, VDD=12V,   fv= 60Hz, f_{DCLK}=148.5MHz, Dim = 100%)

Item		Symbol	Condition	Min.	Typ.	Max.	Unit	Note
Contrast Ratio (Center of screen)		C/R		*3000	5000	-		(3) SR-3A
Response Time	G-to-G [AVE]	Tg		-	8	16	msec	(5) RD-80S
Luminance of White (Center of screen)		Y_L	Normal θ**L,R**=0 θ**U,D**=0 Viewing Angle	380	450	-	cd/m^2	(6) SR-3A
Color Chromaticity (CIE 1931)	Red	Rx			0.640			(7),(8) SR-3A
		Ry			0.332			
	Green	Gx			0.312			
		Gy		TYP. -0.03	0.606	TYP. +0.03		
	Blue	Bx			0.155			
		By			0.053			
	White	Wx			0.280			
		Wy			0.285			
Color Gamut		-		-	70	-	%	(7) SR-3A
Color Temperature		-		-	10000	-	K	(9)
Viewing Angle	Hor.	θ_L	C/R≥10	79	89	-	Degree	(8) EZ-Contrast
		θ_R		79	89	-		
	Ver.	θ_U		79	89	-		
		θ_D		79	89	-		
Brightness Uniformity (9 Points)		B_{uni}		-	-	30	%	(4) SR-3

* CR = (White at point ⑤ of Note 2) / (Most Dark Point of Black Pattern at area ⓐ of Note 2)
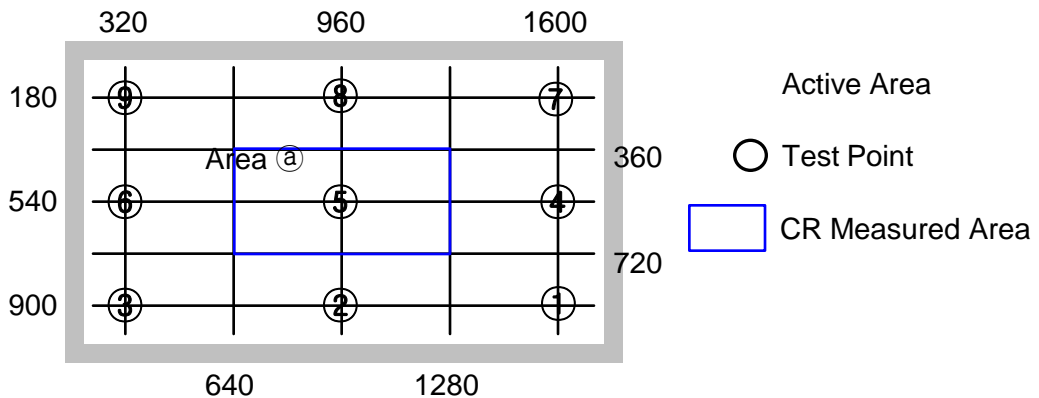
Note (1) Test Equipment Setup

The measurement should be executed in a stable, windless and dark room between 40min and 60min after lighting the back light at the given temperature for stabilization of the back light. This should be measured in the center of screen.

Single lamp current @ Vdim = 100%
Environment condition : Ta = 25 $\pm$ 2 °C

Photo detector	Field
SR-3	1°
BM-7	2°

Photo detector

Field

SR-3 : 50㎝
BM-7 : 50㎝

TFT - LCD Module

LCD Panel

The center of the screen
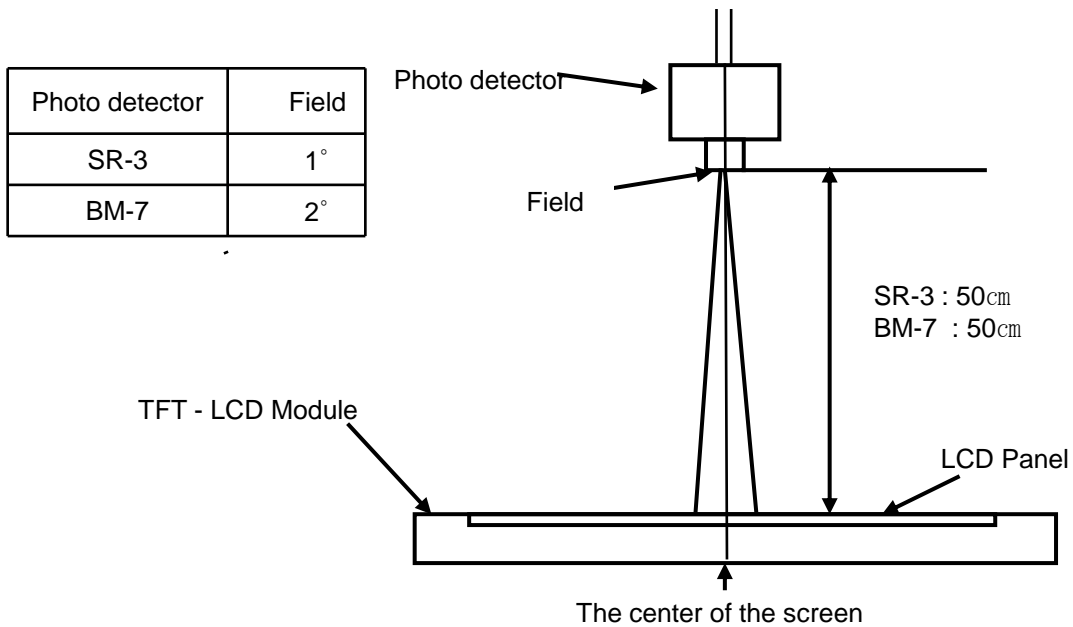
Note (2) Definition of test point

Active Area

○ Test Point

☐ CR Measured Area

Area ⓐ

Note (3) Definition of Contrast Ratio (C/R)
: Ratio of gray max (Gmax) & gray min (Gmin) at the center point ⑤ of the panel

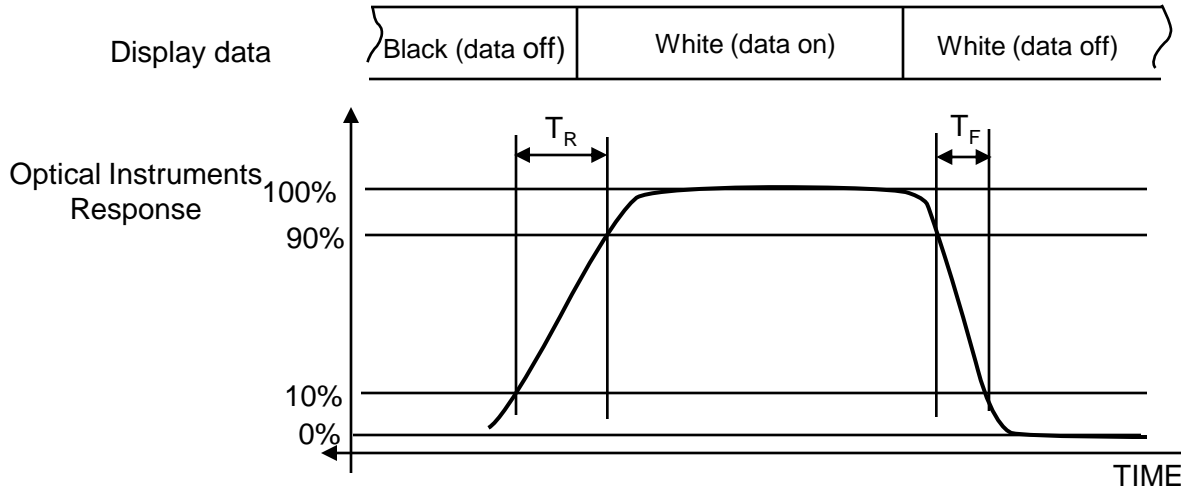$$C/R = \frac{G\max}{G\min}$$

Gmax : Luminance with all pixels white
Gmin : Luminance with all pixels black

Note (4) Definition of 9 points brightness uniformity

$$Buni = 100 * \frac{(B\max - B\min)}{B\max}$$

Bmax : Maximum brightness
Bmin : Minimum brightness

Note (5) Definition of Response time : Sum of Tr, Tf

| Display data | Black (data off) | White (data on) | White (data off) |

Optical Instruments Response

100%
90%

T_R

T_F

10%
0%

TIME

Note (6) Definition of Luminance of White : Luminance of white at center point ⑤

Note (7) Definition of Color Chromaticity (CIE 1931)
Color coordinate of Red, Green, Blue & White at center point ⑤

Note (8) Definition of Viewing Angle
: Viewing angle range (C/R ≥10)

Θ_U

Θ_R

Θ_L

Θ_D
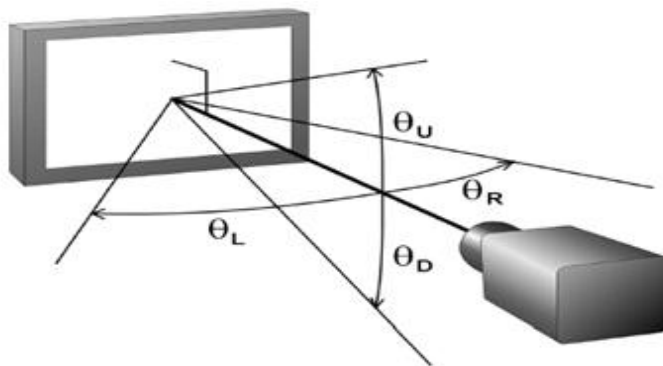
Note (9) Definition of 2 point Gamma

$$Gamma = \log(X_{lum}/100)/\log(Y/100)$$
$$X_{lum} = (Z - B_{\min})/(B_{\max} - B_{\min}) \times 100$$
$$Y: Measurement \quad Level / Z: Measurement \quad Brightness$$
$$B_{\max}: Maximum \quad Brightness / B_{\min}: Minimum \quad Brightness$$

3. Electrical Characteristics

3.1 TFT LCD Module

The connector for display data & timing signal should be connected.

Ta = 25°C $\pm$ 2 °C

Item		Symbol	Min.	Typ.	Max.	Unit	Note
Voltage of Power Supply		V_{DD}	11	12	13	V	(1)
Current of Power Supply	(a) Black	I_{DD}	-	330	380	mA	(2),(3)
	(b) White		-	360	400		
	(c) Mosaic		-	350	390		
	(4) Max Pattern		-	580	650		
Vsync Frequency		f_V	47	60	62	Hz	
Hsync Frequency		f_H	50	67.5	73	kHz	
Main Frequency		f_{DCLK}	130	148.5	155	MHz	
Rush Current		I_{RUSH}	-	-	3	A	(4)

Note (1) The ripple voltage should be controlled under 10% of V_{DD}.
(2) f_V=60Hz, f_{DCLK} = 148.5MHz, V_{DD} = 12.0V, DC Current.
(3) Power dissipation check pattern (LCD Module only)
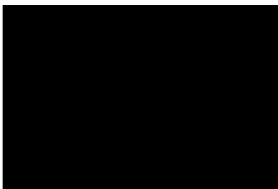
a) Black Pattern   b) White Pattern   c) Mosaic   d) Max. Pattern
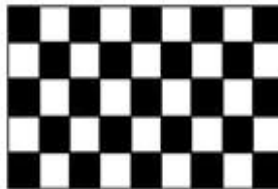
(4) Measurement Conditions

100% ———————
90% ———————
10% ———————
GND ———————
V_{DD}

T_{RUSH}=470us
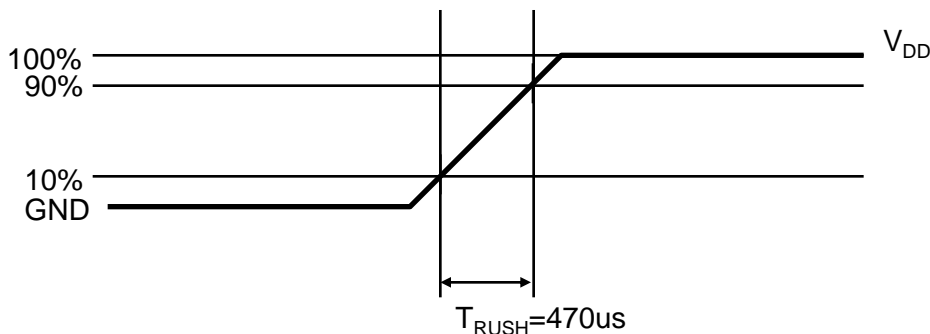
Rush Current I_{RUSH} can be measured when T_{RUSH}. is1ms

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4. Input Terminal Pin Assignment

4.1. Input Signal & Power of Control Board

1. 51Pin Connector : FI-RNE51SZ-HF (JAE)

PIN No.	Signal	Description	PIN No.	Signal	Description
1	Vin	Power	26	RE[0]P	Even LVDS Signal +
2	Vin	Power	27	RE[1]N	Even LVDS Signal -
3	Vin	Power	28	RE[1]P	Even LVDS Signal +
4	Vin	Power	29	RE[2]N	Even LVDS Signal -
5	Vin	Power	30	RE[2]P	Even LVDS Signal +
6	N.C.	No Connection	31	GND	GND
7	GND	GND	32	RECLKN	Even LVDS CLK -
8	GND	GND	33	RECLKP	Even LVDS CLK +
9	GND	GND	34	GND	GND
10	RO[0]N	Odd LVDS Signal -	35	RE[3]N	Even LVDS Signal -
11	RO[0]P	Odd LVDS Signal +	36	RE[3]P	Even LVDS Signal +
12	RO[1]N	Odd LVDS Signal -	37	RE[4]N	Even LVDS Signal -
13	RO[1]P	Odd LVDS Signal +	38	RE[4]P	Even LVDS Signal +
14	RO[2]N	Odd LVDS Signal -	39	GND	GND
15	RO[2]P	Odd LVDS Signal +	40	N.C.	No Connection
16	GND	GND	41	N.C.	No Connection
17	ROCLKN	Odd LVDS CLK -	42	N.C.	No Connection
18	ROCLKP	Odd LVDS CLK +	43	N.C.	No Connection
19	GND	GND	44	N.C.	No Connection
20	RO[3]N	Odd LVDS Signal -	45	N.C.	No Connection
21	RO[3]P	Odd LVDS Signal +	46	N.C.	No Connection
22	RO[4]N	Odd LVDS Signal -	47	N.C.	No Connection
23	RO[4]P	Odd LVDS Signal +	48	N.C.	No Connection
24	GND	GND	49	N.C.	No Connection
25	RE[0]N	Even LVDS Signal -	50	N.C.	No Connection
			51	LVDS OPT	LVDS Option

■ Option Pin Description

These pins are CMOS interface.

Please use within the range of the following restriction.

VIH：2.4V(min) / 3.5V(max)

VIL：0.0V(min) / 0.4V(max)

Note(1) Pin number starts from Right side

PCB

A. 51 Pin

#1   #51

CON1

#1   #51
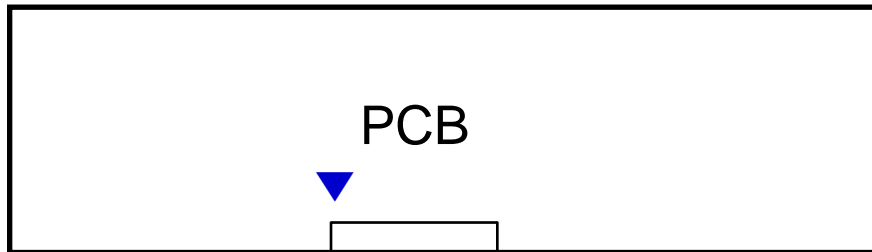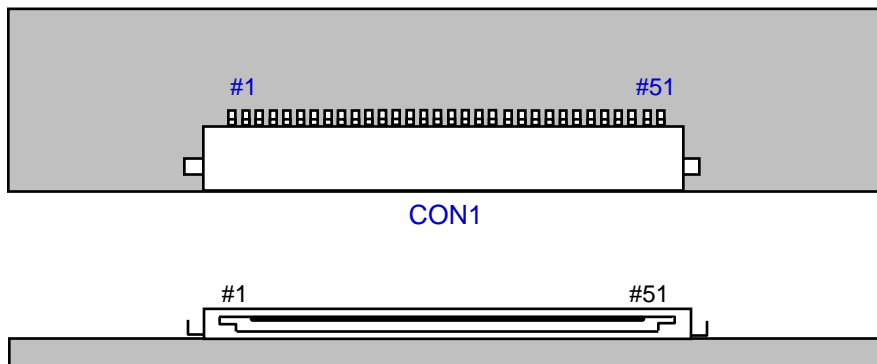
Fig. Connector diagram

a. All GND pins should be connected together and also be connected to the LCD's metal chassis.
b. All power input pins should be connected together.
c. All NC pins should be separated from other signal or power.

4.2. LS Bar Input Pin Configuration

1. CONNECTOR :   Morex/51103-040

Pin	Pin Configuration (Function)
1	DC Voltage (+)
2	N.C.
3	N.C.
4	DC Voltage (+)

2. CONNECTOR : Morex/51103-0500

Pin	Pin Configuration (Function)
1	Feedback
2	N.C.
3	N.C.
4	Feedback
5	N.C.

4.3 LVDS Interface

	LVDS pin	Odd Data	Even Data
TxOUT/RxIN0	TxIN/RxOUT0	R4	R4
	TxIN/RxOUT1	R5	R5
	TxIN/RxOUT2	R6	R6
	TxIN/RxOUT3	R7	R7
	TxIN/RxOUT4	R8	R8
	TxIN/RxOUT6	R9	R9
	TxIN/RxOUT7	G4	G4
TxOUT/RxIN1	TxIN/RxOUT8	G5	G5
	TxIN/RxOUT9	G6	G6
	TxIN/RxOUT12	G7	G7
	TxIN/RxOUT13	G8	G8
	TxIN/RxOUT14	G9	G9
	TxIN/RxOUT15	B4	B4
	TxIN/RxOUT18	B5	B5
TxOUT/RxIN2	TxIN/RxOUT19	B6	B6
	TxIN/RxOUT20	B7	B7
	TxIN/RxOUT21	B8	B8
	TxIN/RxOUT22	B9	B9
	TxIN/RxOUT24	HSYNC	HSYNC
	TxIN/RxOUT25	VSYNC	VSYNC
	TxIN/RxOUT26	DEN	DEN
TxOUT/RxIN3	TxIN/RxOUT27	R2	R2
	TxIN/RxOUT5	R3	R3
	TxIN/RxOUT10	G2	G2
	TxIN/RxOUT11	G3	G3
	TxIN/RxOUT16	B2	B2
	TxIN/RxOUT17	B3	B3
	TxIN/RxOUT23	Reserved	Reserved
TxOUT/RxIN4	TxIN/RxOUT28	R0	R0
	TxIN/RxOUT29	R1	R1
	TxIN/RxOUT30	G0	G0
	TxIN/RxOUT31	G1	G1
	TxIN/RxOUT32	B0	B0
	TxIN/RxOUT33	B1	B1
	TxIN/RxOUT34	Reserved	Reserved

COLOR	DISPLAY (10bit)	RED R0	R1	R2	R3	R4	R5	R6	R7	R8	R9	GREEN G0	G1	G2	G3	G4	G5	G6	G7	G8	G9	BLUE B0	B1	B2	B3	B4	B5	B6	B7	B8	B9	GRAY SCALE LEVEL
BASIC COLOR	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	-
	GREEN	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	-
	CYAN	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
	RED	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-
	MAGENTA	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	-
	YELLOW	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	-
	WHITE	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	-
GRAY SCALE OF RED	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R0
	DARK ↑	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1
		0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R2
		:	:	:	:	:	:					:	:	:	:	:	:					:	:		:	:	:	:				R3~ R1020
		:	:	:	:	:	:					:	:	:	:	:	:					:	:		:	:	:	:				
	LIGHT ↓	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1021
		0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1022
	RED	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	R1023
GRAY SCALE OF GREEN	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G0
	DARK ↑	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G1
		0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	G2
		:	:	:	:	:	:					:	:	:	:	:	:					:	:		:	:	:	:				G3~ G1020
		:	:	:	:	:	:					:	:	:	:	:	:					:	:		:	:	:	:				
	LIGHT ↓	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	G1021
		0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	G1022
	GREEN	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	G1023
GRAY SCALE OF BLUE	BLACK	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B0
	DARK ↑	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	B1
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	B2
		:	:	:	:	:	:					:	:	:	:	:	:					:	:	:	:	:	:	:				B3~ B1020
		:	:	:	:	:	:					:	:	:	:	:	:					:	:	:	:	:	:	:				
	LIGHT ↓	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	1	1	1	1	1	1	1	B1021
		0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	B1022
	BLUE	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	B1023

Note) Definition of Gray :
  Rn : Red Gray, Gn : Green Gray, Bn : Blue Gray (n = Gray level)
 Input Signal : 0 = Low level voltage, 1 = High level voltage

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5. Interface Timing

5.1 Timing Parameters
5.1.1 DE Only Mode

SIGNAL	ITEM	SYMBOL	MIN.	TYP.	MAX.	Unit	Note
Clock		1/Tc	130.00	148.50	155.00	MHz	
Hsync	Frequency	FH	50	67.5	73	kHz	Polarity : Negative
Vsync		FV	47	60	63	Hz	Polarity : Negative
Vertical Active	Display Period	TVD	1080	1080	1080	Lines	
	Vertical Total	TV	1100	1125	1480	Lines	
Horizontal Active	Display Period	THD	1920	1920	1920	clocks	
	Hrizontal Total	TH	2145	2200	2450	clocks	

5.2 Timing diagrams of interface signal (DE only mode)

| MODEL | LTA320HN05 | Doc. No | 05-000-G-20120326 | Page | **17/25** |
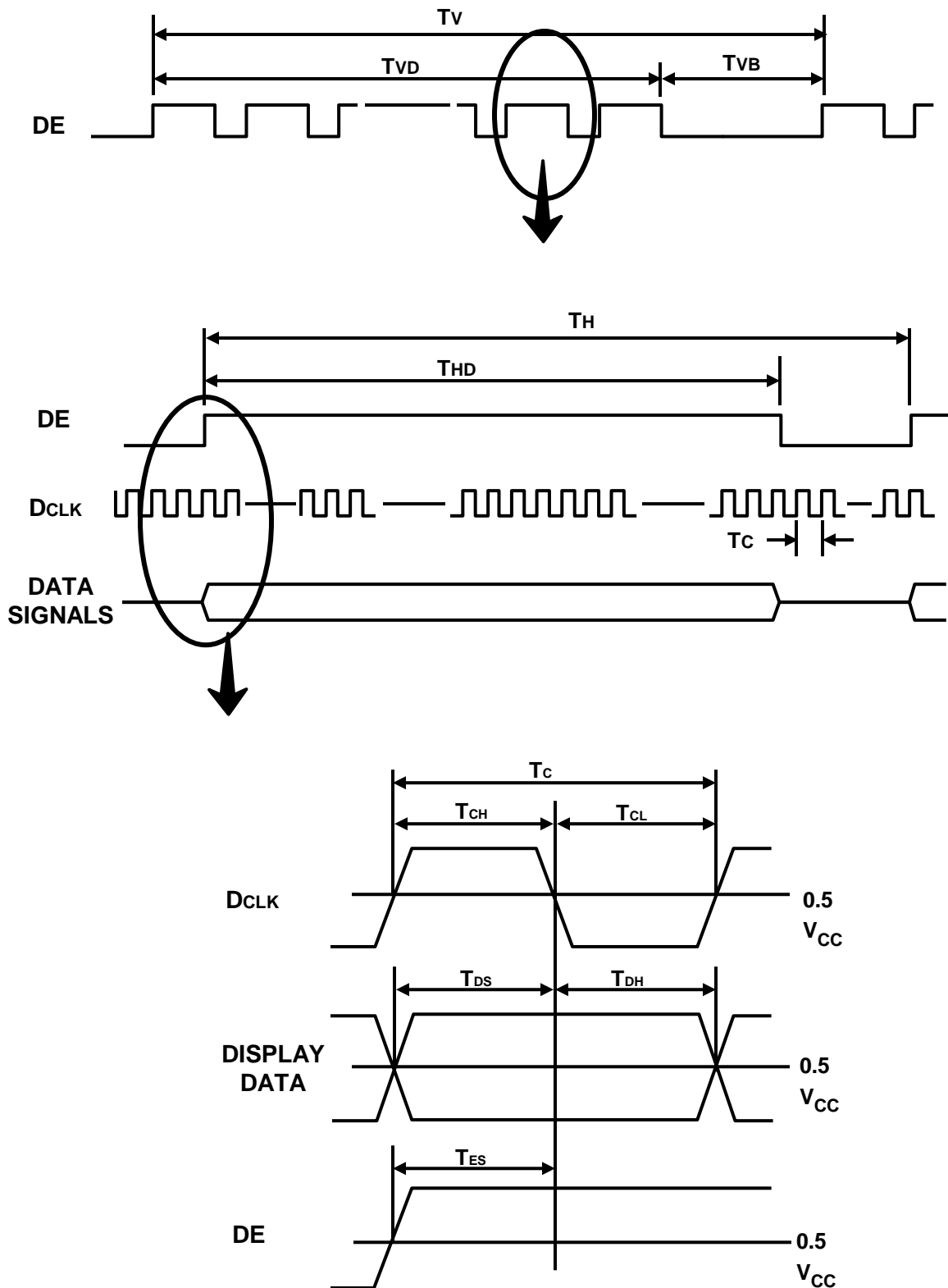
5.3 Power ON/OFF Sequence

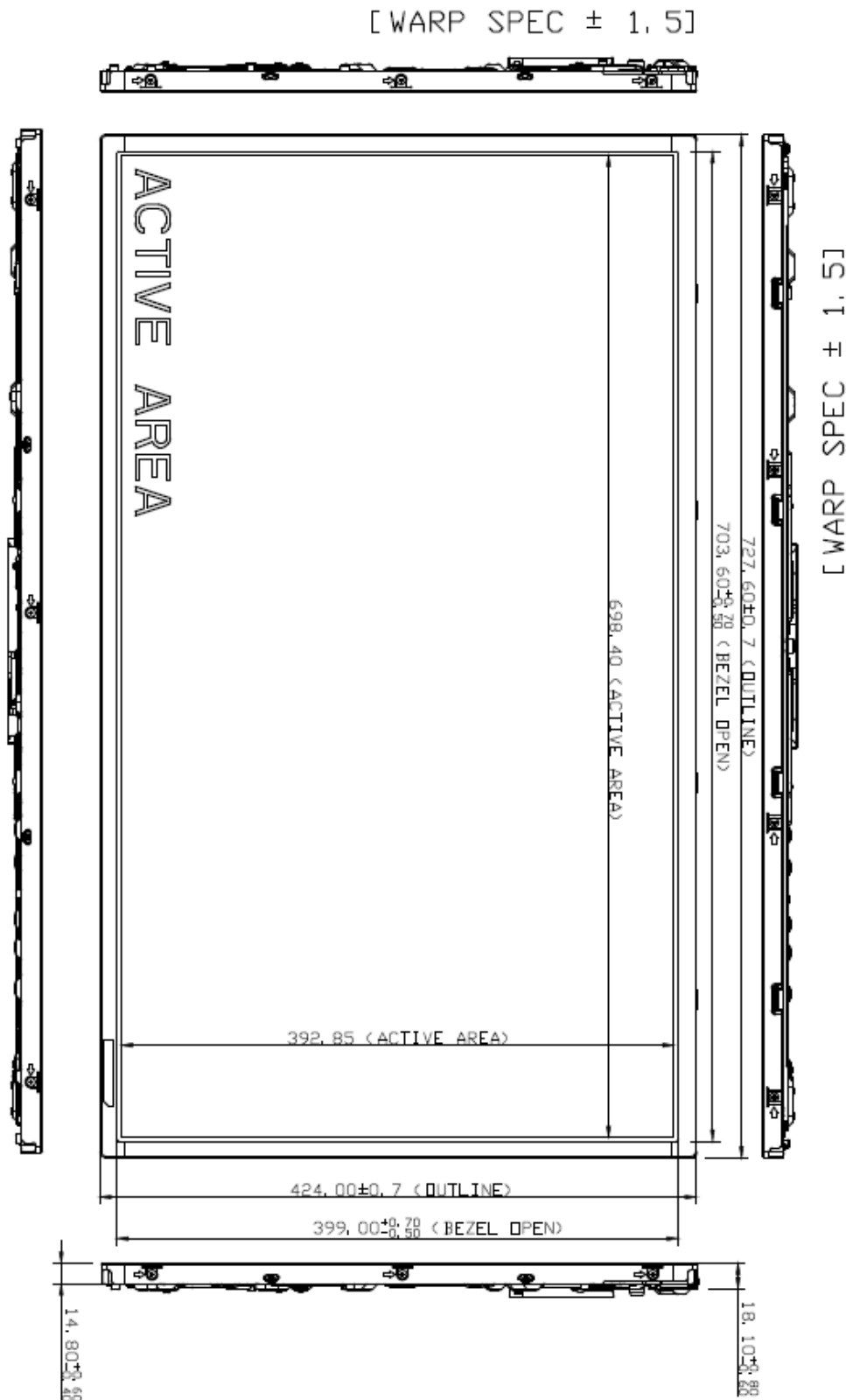To prevent a latch-up or DC operation of the LCD Module, the power on/off sequence should be as the diagram below.

0.9V_{DD}
Panel 12V 0.1V_{DD}
0V
0.9V_{DD}
0.1V_{DD}
T1
T2
T3
T4
VALID
0V
Power On
Power Off
T5
T6
50%   50%
300 ms
T-Con Ready
0V
T8   T8
0.9V_{DD}
0.1V_{DD}
0V
DCC LUT Selection Enable Period

0.47ms<T1≤30ms
10ms<T2≤50ms
0ms<T3≤50ms
1000ms <T4
550ms≤T5
60ms≤T6
1ms ≤T8
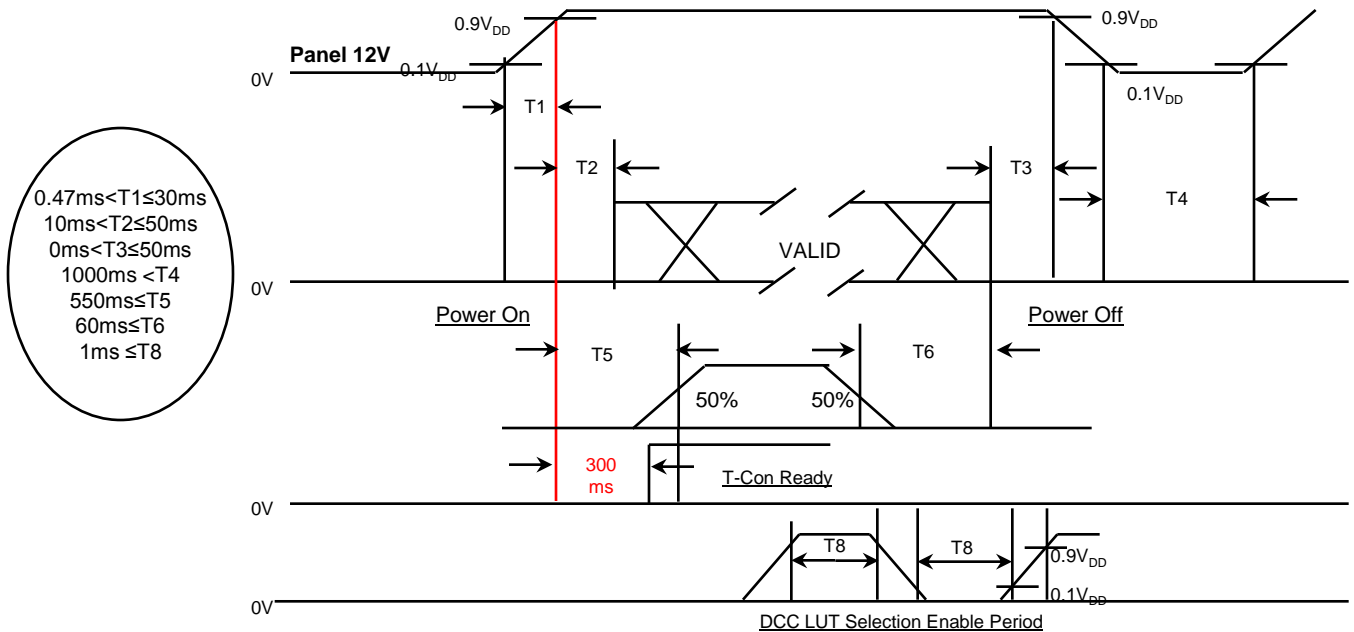
T1 : V_{DD} rising time from 10% to 90%
T2 : The time from V_{DD} to valid data at power ON.
T3 : The time from valid data off to V_{DD} off at power Off.
T4 : V_{DD} off time for Windows restart
T5 : The time from valid data to B/L enable at power ON.
T6 : The time from valid data off to B/L disable at power Off.
T8 : DCC LUT Selection Enable Period.

[Valid Data Condition]
1. Input LVDS signals must satisfy "Interface Timing" Specification on p23.
2. LVDS Clock must keep the same frequency.
3. "Temp SEL" signal should be changed within Tcon Reset and Tcon Ready.
4. Data signal should not input during "Fail Safe Mode".

- The supply voltage of the external system for the Module input should be the same as the definition of V_{DD}.
- Apply the lamp voltage within the LCD operation range. When the back light turns on before the LCD operation or the LCD turns off before the back light turns off, the display may momentarily show abnormal screen.
- In case of V_{DD} = off level, please keep the level of input signals low or keep a high impedance.
- T4 should be measured after the Module has been fully discharged between power off and on period.
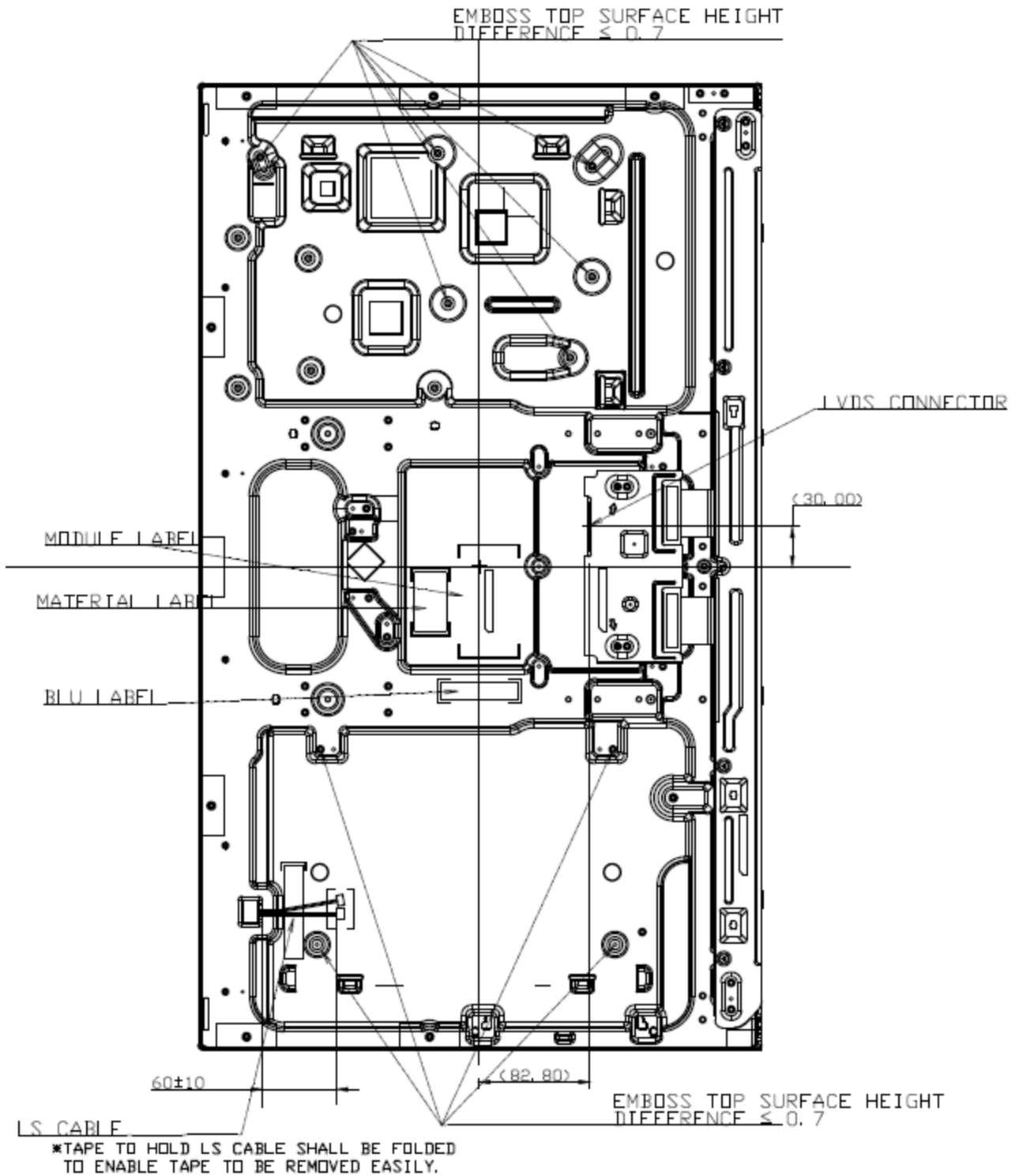- Interface signal should not be kept at high impedance when the power is on.

6.1 Outline Dimension
a. Front View

[WARP SPEC ± 1.5]

[WARP SPEC ± 1.5]

ACTIVE AREA

727.60±0.7 (OUTLINE)

703.60$^{+0.70}_{-0.50}$ (BEZEL OPEN)

698.40 (ACTIVE AREA)

392.85 (ACTIVE AREA)

424.00±0.7 (OUTLINE)

399.00$^{+0.70}_{-0.50}$ (BEZEL OPEN)

14.80$^{+0.60}_{-0.40}$

18.10$^{+0.80}_{-0.60}$

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EMBOSS TOP SURFACE HEIGHT DIFFERENCE ≤ 0.7

LVDS CONNECTOR

(30.00)

MODULE LABEL

MATERIAL LABEL

BLU LABEL

60±10

(82.80)

EMBOSS TOP SURFACE HEIGHT DIFFERENCE ≤ 0.7

LS CABLE
*TAPE TO HOLD LS CABLE SHALL BE FOLDED
TO ENABLE TAPE TO BE REMOVED EASILY.

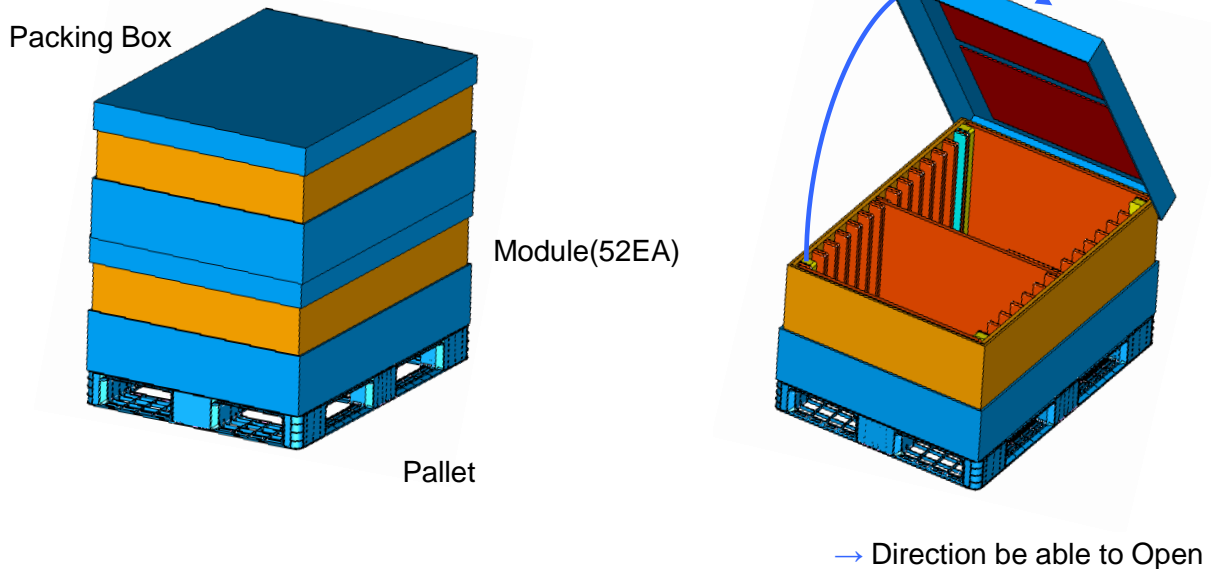| MODEL | LTA320HN05 | Doc. No | 05-000-G-20120326 | Page | 20/25 |

7. PACKING

7.1 CARTON (Internal Package)
(1) Packing Form
Corrugated fiberboard box and corrugated cardboard as shock absorber
(2) Packing Method

Packing Box

Module(52EA)

Pallet

→ Direction be able to Open

7.2 Packing Specification

Item	Specification	Remark
LCD Packing	26ea / (Packing Box)	1. 260kg/LCD(52ea) 2. 30kg/Packing Box(2set) 3. Packing Box Material : Paper
Desiccant (Drier)	4ea / LCD	10g/ea, Cobalt-dichloride-free
Pallet	2Box / Pallet	Pallet weight : 5.3kg
Packing Direction	Vertical	-
Total Pallet Size	L x W x Height	1150mm x 850mm x 1081mm
Total Pallet Weight	297kg	Pallet(5.3kg) + Module(52 x 5kg = 260kg) + Packing BOX(15 x 2 = 30kg) + Desiccant(0.03kg x 52 = 1.56kg)
Stack Layer	3 layer in warehouse. 2 layer in container.	
Shielding Bag	Compound PE / Sealing / 70μm	Material / Adhesive tape / Thickness
POL Protection Film	PET / 0.125mm	Material / Thickness

8. MARKING & OTHERS

A nameplate bearing followed by is affixed to a shipped product at the specified location on each product.

(1) Parts number : LTY[Z]320HN03-XXX
(2) Revision: One letters
(3) Lot number : X X X X XXX XX X

Cell Position No. (In the Glass)
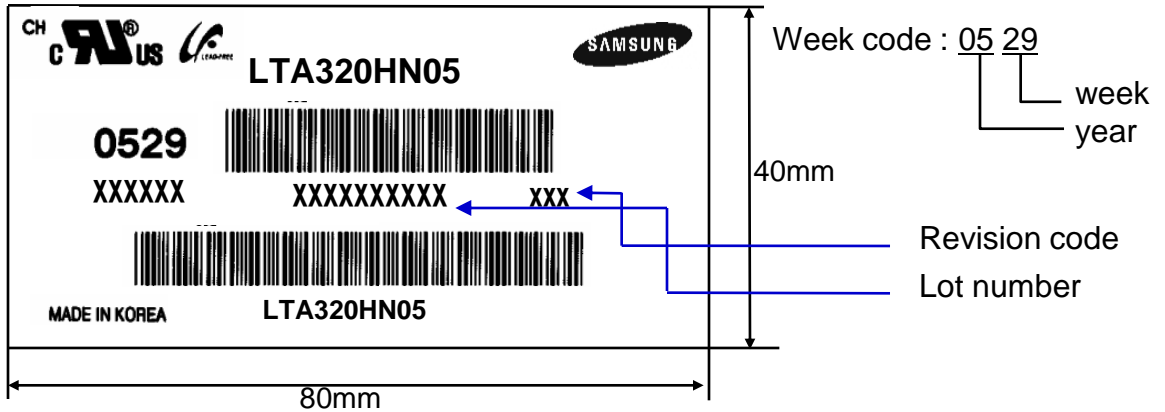Glass No. (In the one Lot)
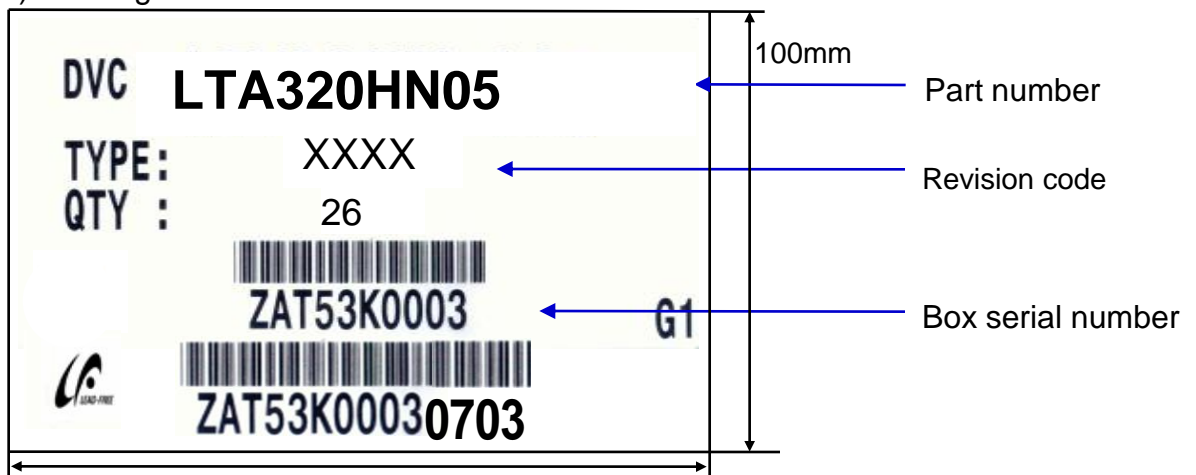Lot No. (Glass)
Month
Year (Note1)
Product code
Line

(4) Nameplate Indication

CH c RU us LEAD-FREE
LTA320HN05
SAMSUNG

0529

XXXXX   XXXXXXXXXX   XXX

MADE IN KOREA   LTA320HN05

40mm

80mm

Week code : 05 29
week
year

Revision code
Lot number

(5) Packing box attach

DVC   **LTA320HN05**
TYPE: XXXX
QTY :   26
‖‖‖‖‖ ZAT53K0003 ‖‖‖‖‖   G1
LEAD-FREE   ‖‖‖‖‖ ZAT53K0003**0703**

100mm

Part number

Revision code

Box serial number

(6) Others
1. After service part
Lamps cannot be replaced because of the narrow bezel structure.

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9. General Precautions

9.1 Handling

(a) When the Module is assembled, it should be attached to the system firmly using all mounting holes. Be careful not to twist and bend the Module.

(b) Because the inverter use high voltage, it should be disconnected from power before it is assembled or disassembled.

(c) Refrain from strong mechanical shock and / or any force to the Module. In addition to damage, this may cause improper operation or damage to the Module and back light.

(d) Note that polarizers are very fragile and could be damage easily. Do not press or scratch the surface harder than a HB pencil lead.

(e) Wipe off water droplets or oil immediately. If you leave the droplets for a long time, staining or discoloration may occur.

(f) If the surface of the polarizer is dirty, clean it using absorbent cotton or soft cloth.

(g) Desirable cleaners are water, IPA(Isopropyl Alcohol) or Hexane. Do not use Ketone type materials(ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanent damage to the polarizer due to chemical reaction.

(h) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth . In case of contact with hands, legs or clothes, it must be washed away with soap thoroughly.

(i) Protect the Module from static, or the CMOS Gate Array IC would be damaged.

(j) Use finger-stalls with soft gloves in order to keep display clean during the incoming inspection and assembly process.

(k) Do not disassemble the Module.

(l) Do not pull or fold the LED FFC.

(m) Do not adjust the variable resistor located on the Module.

(n) Protection film for polarizer on the Module should be slowly peeled off just before use so that the electrostatic charge can be minimized.

(o) Pins of I/F connector should not be touched directly with bare hands.

9.2 Storage

We highly recommend to comply with the criteria in the table below.

Item	Unit	Min.	Max.
Storage Temperature	(℃)	10	40
Storage Humidity	(%rH)	35	75
Storage Life	12 Months		
Storage Condition	- The storage room should provide good ventilation and temperature control. - Products should not be placed on the floor, but on the Pallet away from 　a wall. - Prevent products from direct sunlight, moisture nor water; Be cautious of 　a build up of condensation. - Avoid other hazardous environment while storing goods. - If products delivered or kept in conditions of over the storage period of 3 　months, the recommended temperature or humidity range, 　we recommend you leave them at a temperature of 20℃ and a humidity 　of 50% for 24 hours.		

9.3 Operation

(a) No Connection or disconnect the Module in the "Power On" condition.

(b) Power supply should always be turned on/off by the "Power on/off sequence"

(c) Module has high frequency circuits. Sufficient suppression to the electromagnetic
　interference should be done by system manufacturers. Grounding and shielding methods
　may be important to minimize the interference.

(d) The cable between the back light connector and its Converter power supply should
　be connected directly with a minimized length. A longer cable between
　the back light and the inverter may cause lower luminance of LED and
　may require higher startup voltage(Vs).

9.4 Operation Condition Guide

(a) The LCD product should be operated under normal conditions.
Normal condition is defined as below;
- Temperature : $20\pm15℃$
- Humidity : $55\pm20\%$
- Display pattern : continually changing pattern (Not stationary)

(b) If the product will be used in extreme conditions such as high temperature,
humidity, display patterns or operation time etc.., It is strongly recommended
to contact SEC for Application engineering advice. Otherwise, its reliability and
function may not be guaranteed. Extreme conditions are commonly found at
Airports, Transit Stations, Banks, Stock market, and Controlling systems.

9.5 Others

(a) Ultra-violet ray filter is necessary for outdoor operation.

(b) Avoid condensation of water. It may result in improper operation or disconnection
of electrode.

(c) Do not exceed the absolute maximum rating value. (supply voltage variation,
input voltage variation, variation in part contents and environmental temperature,
and so on)
Otherwise the Module may be damaged.

(d) If the Module keeps displaying the same pattern for a long period of time,
the image may be "sticked" to the screen.
To avoid image sticking, it is recommended to use a screen saver.

(e) This Module has its circuitry PCB's on the rear side and should be handled
carefully in order not to be stressed.

(f) Please contact SEC in advance when you display the same pattern for a long time.